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Does Digital Financial Inclusion Influence Corporate Charitable Donations? Evidence from China's Digital Transformation

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Abstract. The primary objective of this research is to explore the manner in which Digital Financial Inclusion (DFI) exerts an influence on Corporate Charitable Donations (CCD), while also investigating the mediating function of Digital Transformation (DT) and the moderating role of CEO Green Experience (CGE). By utilizing panel data sourced from Chinese-listed companies spanning the period from 2015 to 2022, this study adopts multiple regression models to conduct empirical analysis. The key results of the research are summarized below: (1) DFI exerts a notably positive impact on CCD. This outcome demonstrates that the widespread expansion of digital financial services serves as an effective driver in promoting corporate philanthropic activities. (2) DT acts as a partial mediator in the relationship between DFI and CCD. This implies that enterprises can strengthen the positive effect of DFI on charitable donations by advancing their internal digitalization efforts. (3) CGE plays a positive moderating role in the connection between DFI and CCD. In other words, CEOs who possess backgrounds in environmental fields are better equipped to utilize digital financial tools, thereby enhancing the performance of corporate social responsibility. Additionally, a heterogeneity analysis reveals that the impact of DFI on CCD differs across various regions and ownership structures. Specifically, the effect is most prominent in the Northeast region, and it is more distinct in non-state-owned enterprises. This research not only contributes to the enrichment of academic literature related to digital finance and corporate social responsibility but also offers empirical evidence and practical insights. For enterprises, it provides guidance on how to leverage digital tools to fulfill social responsibilities; for policymakers, it offers valuable references for optimizing the digital finance environment.

Keywords: Digital Financial Inclusion; CEO Green Experience; Corporate Charitable Donations; Digital Transformation

1. Introduction

Digital Financial Inclusion (DFI), which expands financial access and utilization through technologies like mobile payments and internet banking (Lee et al., 2022; Liu et al., 2021; Rajunčius, & Miečinskienė,2024; Thuong,2024), is a crucial force for economic growth, especially in developing countries like China (Xu et al., 2024). However, its role in promoting Corporate Charitable Donations (CCD) remains underexplored.

Unlike individual donations, corporate giving is strategic, making convenience a secondary concern (Schönwälder & Weber, 2024). The key is understanding how DFI creates economic incentives—such as an enhanced corporate image and market position—that drive donation behavior. Economic incentives are established drivers of corporate giving (Hanlon, 2022; Jing et al., 2023; Khan et al., 2023), and DFI contributes by increasing the transparency and accountability of donations, which effectively builds a firm's reputation and stakeholder trust (Javaid, 2022; Skare, 2023).

As a key element of Corporate Social Responsibility (CSR) (Wang et al., 2023; Peterson et al., 2021), CCD can be amplified through digital platforms that align philanthropic efforts with business goals (Lin et al., 2024). Despite this, the role of Digital Transformation (DT) is often overlooked in the literature. DT, the integration of digital technologies to improve efficiency and competitiveness (Chen & Xu, 2023; Han &Ali ,2025; Paudel. & Thapa, 2025), enhances operations and decision-making (Dou et al., 2023; Tang et al., 2023) and may therefore mediate the relationship between DFI and CCD.

Furthermore, a CEO's Green Experience (CGE) may also influence corporate donation strategies (Huang & Wei, 2023). Environmentally conscious CEOs are more likely to promote sustainability and social responsibility initiatives (Musah et al., 2023), suggesting CGE could moderate the positive relationship between DFI and CCD.

This research aims to dissect the complex interactions between DFI, CCD, DT, and CGE, offering new insights into how digital financial inclusion can enhance corporate charitable donations. Specifically, the study seeks to address the following research questions:

RQ 1: What is the impact of DFI on CCD?

RQ 2: To what extent does DT mediate the relationship between DFI and CCD?

RQ 3: How does CGE moderate the relationship between DFI and CCD?

By addressing these questions, the study contributes to the growing body of literature on the role of digital finance in CSR and corporate philanthropy. Moreover, it offers practical insights for businesses seeking to integrate digital tools into their CSR strategies, as well as for policymakers aiming to foster a supportive environment for digital financial inclusion and sustainable business practices.

The remainder of this paper is organized as follows: Section 2 presents the literature review and research hypotheses. Section 3 describes the data sources and methodologies. Section 4 discusses the findings and their implications, while Section 5 concludes with key takeaways and actionable recommendations.

2. Literature Review and Research Hypotheses

2.1. Digital Financial Inclusion and the Corporate Charitable Donations

Digital Financial Inclusion (DFI) leverages technologies like mobile banking and blockchain to expand financial access (Lee et al., 2022; Liu et al., 2021), yet its relationship with Corporate Charitable Donations (CCD) remains underexplored in the literature.

Emerging research suggests DFI facilitates corporate philanthropy (Ma & Jiang, 2024) by enhancing the transparency, traceability, and efficiency of charitable activities (Veile et al., 2022). For example, real-time tracking of donations via digital payment systems builds public trust and improves

corporate social image, which can motivate further giving (Silva, 2021; Dhar et al., 2022).

Beyond efficiency, DFI also drives innovation in philanthropic models through tools like digital wallets and crowdfunding platforms, aligning financial performance with social responsibility to create both economic and social value (Sun & You, 2023; Leone et al., 2023; Okafor et al., 2021).

The influence of DFI on corporate giving varies by industry and organizational characteristics (Chen et al., 2021). Sectors with higher digital penetration, such as finance and technology, are more likely to adopt advanced digital donation strategies (Elsaid et al., 2023; Mhlanga et al., 2020), while internal factors like firm size and culture also play a key role.

Given that DFI can help firms align their financial and social goals more effectively, we propose the following hypothesis based on the existing literature:

H1: DFI within organizational processes positively influences CCD.

2.2. Mediating Effect of Digital Transformation

Digital Transformation (DT) enhances enterprise efficiency and innovation (Ghosh et al., 2022; Zhang et al., 2023) by optimizing business processes and reducing operational costs (Peng & Tao, 2022). This technological evolution profoundly impacts Corporate Social Responsibility (CSR) activities, especially Corporate Charitable Donations (CCD), by improving their transparency, efficiency, and strategic alignment.

Research shows that digital tools like blockchain and mobile banking enable real-time tracking of donations, which increases the transparency and accountability of donation management. This helps build stakeholder trust and enhance corporate social credibility (Stabb & Marcason-Tolmie, 2023; Dhar et al., 2022). Concurrently, DT broadens public participation and the impact of charitable activities through digital channels like social media, integrating philanthropy more closely into the business model (Zhong & Ren, 2023).

In the context of Digital Financial Inclusion (DFI), DT is crucial for creating inclusive donation platforms (Modgil, 2022). According to Resource Dependency Theory (RDT), firms rely on external resources like technology to maintain competitiveness (Cordeiro et al., 2020). DT enables firms to effectively leverage digital resources to improve CSR performance (Mishra & Yadav, 2021) and optimize the allocation of internal resources to charitable activities, thereby strengthening stakeholder relationships (Oliveira et al., 2022; Ahsan et al., 2024).

Therefore, Digital Transformation serves as a pivotal mediator between DFI and CCD. By embracing DT, companies can better utilize digital financial tools, amplifying the benefits of DFI to achieve more efficient, transparent, and impactful corporate philanthropy. Based on this, we propose the following hypothesis:

H2: DT significantly mediates the positive impact of DFI on CCD.

2.3. Moderating role of CEO Green Experience

CEO Green Experience (CGE), which encompasses the environmental awareness and expertise of a firm's leader, is known to shape corporate strategy, including Corporate Social Responsibility (CSR) and Corporate Charitable Donations (CCD) (Huang & Wei, 2023; Li et al., 2024). Upper Echelons Theory (UET) provides a framework for this, positing that the personal values and experiences of executives directly influence organizational outcomes (Ali et al., 2022).

CEOs with CGE are more likely to integrate sustainability with financial inclusion efforts, viewing them as interconnected (Musah et al., 2023). They tend to direct charitable activities strategically to meet Environmental, Social, and Governance (ESG) criteria, which can improve the firm’s ESG ratings and enhance stakeholder trust (Bhattacharyya & Khan, 2023; Liu et al., 2023; Okike et al., 2023). Furthermore, these leaders often champion green innovations, making them more inclined to adopt new

technologies (Quan et al., 2021; He et al., 2021).

This innovative mindset is particularly relevant for leveraging Digital Financial Inclusion (DFI). CEOs with CGE are more likely to recognize the potential of digital tools to make charitable donations more transparent, efficient, and impactful. However, a gap exists in understanding how CGE specifically moderates the relationship between DFI and CCD.

We argue that CGE strengthens the positive effect of DFI on CCD. Leaders with green experience foster a corporate culture of sustainability and accountability that aligns with DFI's principles. They are better equipped to strategically deploy digital platforms to ensure charitable funds are used effectively, maximizing the social and environmental impact of the company's donations (Okike et al., 2023). This strategic alignment is critical for optimizing the social value created through DFI-driven philanthropy.

Based on the above discussion, we propose the following hypothesis:

H3: CEO Green Experience (CGE) strengthens the positive impact of Digital Financial Inclusion (DFI) on Corporate Charitable Donations (CCD).

3. Data and Methods

3.1. Model preparation

3.1.1. Data and Sample

Our study uses data from Chinese-listed firms from 2015 to 2022, focusing on a comprehensive sample of 22,929 firms after excluding financially distressed companies (ST exclusion). The exclusion of such firms helps mitigate the potential bias introduced by their financial instability, ensuring the robustness of our findings. Data were primarily sourced from the China Stock Market and Accounting Research (CSMAR) and Flush databases, which are widely recognized for providing reliable financial information on Chinese-listed companies. These datasets were supplemented by regional digital financial inclusion data provided by Peking University's Digital Financial Inclusion Research Center. The analysis was conducted using Stata 14.0 software to perform the statistical procedures. The variables included in the study are summarized in Table 1, which encompasses key constructs such as digital financial inclusion, corporate governance characteristics, and corporate charitable activities.

3.1.2. Independent Variable

The key independent variable in this study is Digital Financial Inclusion (DFI), which measures the degree of regional engagement in digital finance. The DFI index is a composite score reflecting the availability and usage of various digital financial services, including mobile payments, internet banking, and digital loans (Niu et al., 2022; Lu et al., 2022). The index provides an aggregate measure of digital financial inclusion across different regions in China, capturing the regional disparities in access to digital financial services. To correct for the skewness in the distribution of the DFI data, the natural logarithm of the DFI index is used in the regression analysis. This transformation ensures a more normal distribution, allowing for more robust econometric modeling. Additionally, it helps capture the diminishing marginal effects of increasing DFI on corporate behaviors, which is critical for accurately estimating the relationship between DFI and CCD.

3.1.3. Dependent Variable

Corporate Charitable Donations (CCD) is the dependent variable in this study, measured by the total annual monetary value of donations reported by firms in their financial statements. This measure reflects a firm's commitment to social responsibility through charitable giving, which is a key component of corporate social responsibility (CSR). The donation data are extracted from the CSMAR database, ensuring a high level of reliability and coverage across the sample period. To address potential

skewness in donation amounts, the natural logarithm of non-zero donation values is used in the regression analysis. This transformation not only addresses distributional concerns but also ensures that small and large donations are more appropriately scaled, improving the precision of the regression estimates.

3.1.4. Mechanism Variables

To explore how the application of digital technologies shapes the connection between Digital Financial Inclusion (DFI) and Corporate Charitable Donations (CCD), Digital Transformation (DT) is incorporated into the study as a mediating variable. The measurement of DT relies on counting the occurrences of digital transformation-related keywords—such as "digital technology," "blockchain," and "artificial intelligence"—within the Management Discussion and Analysis (MD&A) segment of companies' annual reports (Zhai et al., 2022). To maintain comparability across enterprises of varying scales, the frequency of these keywords is first standardized against the total length of the MD&A section, and the resulting value is then multiplied by 100 (Li et al., 2023; Jiang et al., 2023; Liu & Wang, 2023). This measurement approach effectively reflects the degree to which firms are proactively incorporating digital technologies into their operational workflows and strategic planning, thereby indicating the level of digital transformation achieved by each company.

As a moderating variable, CEO Green Experience (CGE) is introduced to test whether chief executives with environmental expertise are more capable of strengthening the positive influence of DFI on CCD. CGE is defined as a binary variable: a score of 1 is assigned when a CEO possesses considerable experience in environmental leadership or green business operations (Zhang & Zhang, 2023). This classification is determined by examining the CEO's professional background, which includes past positions in environmental industries, academic qualifications in sustainability or relevant disciplines, and proven leadership in driving green projects. In contrast, a score of 0 is given if the CEO does not have notable green-related experience. Through this variable, the study can verify whether leadership with a strong environmental awareness boosts the extent to which firms engage in charitable donations, where such donations are supported by digital financial inclusion.

3.1.5. Control Variables

To secure the robustness of our analytical findings, we integrate a range of control variables into the study. These variables are specified as follows Table 1:

- **Company Size,** which is operationalized as the natural logarithm of total assets, and is included to account for the potential impacts of firm scale;
- **Financial Leverage,** measured by the debt-to-asset ratio, used to capture the level of financial risk borne by enterprises;
- **Return on Equity (ROE),** employed to reflect the profitability performance of the sampled firms;
- **Financial Growth,** represented by the annual revenue growth rate, designed to indicate the expansion trends and dynamics of companies;
- **Ownership Concentration,** quantified as the shareholding percentage of the largest shareholder, serving to measure the degree of control over the firm;
- **Tobin's Q,** calculated as the ratio of market value to asset value, which helps assess the market valuation level of enterprises;
- **Auditor Opinion,** a categorical variable derived from the auditor's report, utilized to gauge the credibility of firms' financial statements.

The incorporation of these control variables plays a key role in helping us isolate and accurately identify the specific impact of Digital Financial Inclusion (DFI) on (CCD).

Table 1: Summary of variables measurement

Variables	Symbol	Measurement	Type
Digital financial inclusion	DFI	Natural logarithm of provincial digital financial inclusion index	Independent
CEO Green Experience	CGE	The variable "Green" assumes the value of 1 if the CEO of the firm possesses experience in the field of green business, and otherwise, it assumes the value of 0	Moderating
Corporate charitable donations	CCD	Corporate charitable donations (CDD) are measured as the total amount of donations made by firms over the course of the year. Since this data is skewed, this paper takes the natural logarithm of all non-zero donations	Dependent
Digital Transformation	DT	Calculated by normalizing keyword frequency by the length of the Management Discussion and Analysis (MD&A) section in annual reports, multiplied by 100 to ease interpretation	Mediating
Company size	Size	This metric accounts for scale effects and provides a standardized way to compare firms of different sizes. The natural logarithm transformation is used to normalize the distribution of company size, making it more suitable for regression analysis.	Control
Financial leverage	Lev	Debt-to-asset ratio	
Return on Equity	ROE	ROE is a measure of a firm's profitability that calculates how much profit a company generates with the money shareholders have invested. It is defined as the ratio of net income to shareholders' equity.	
Financial Growth	Growth	Annual revenue growth rate	
Ownership Concentration	Top1	Percentage Ownership by Top 3 Shareholders	
Market Valuation over Asset Value	TobinQ	This ratio is used as an alternative valuation metric, providing insight into a company’s value from a different perspective	
Auditor Opinion	Opinion	Count specific qualifications or issues raised in the audit report, providing a more nuanced measure	

3.2. Model specification

3.2.1. Benchmark regression model construction

To establish a foundational understanding of the influences on CCD within firms, we develop a benchmark regression model, which is detailed in Equation (1). This model aims to assess the direct influence of Digital Financial Inclusion (DFI) (incorporating Analyst Attention) on CCD, while also controlling for a full range of firm-specific traits and market-related circumstances：

$$CCD_{i,t} = \beta_0 + \beta_1 DFI_{i,t} + \beta_2 Size_{i,t} + \beta_3 Lev_{i,t} + \beta_4 ROE_{i,t} + \beta_5 Growth_{i,t} + \beta_6 Top1_{i,t} + \beta_7 TobinQ_{i,t} + \beta_8 Opinion_{i,t} + \sum Year_{i,t} + \sum Industry_{i,t} + \varepsilon_{i,t}$$

Eq. (1)

3.2.2. Mediator effect regression model construction

Taking the benchmark model as a foundation, we further probe into the mediating function of digital transformation (DT) in the association between Digital Financial Inclusion (DFI) and Corporate Charitable Donations (CCD). The test for this mediating effect is carried out in two phases, following the specifications outlined in Equations (2) and (3).

First-Stage Mediation Model:

$$DT_{i,t} = \alpha_0 + \alpha_1 DFI_{i,t} + \alpha_2 Size_{i,t} + \alpha_3 Lev_{i,t} + \alpha_4 ROE_{i,t} + \alpha_5 Growth_{i,t} + \alpha_6 TOP1_{i,t} + \alpha_7 TobinQ_{i,t} + \alpha_8 Opinion_{i,t} + \sum Year_{i,t} + \sum Industry_{i,t} + \mu_{i,t}$$

Second-Stage Mediation Model:

Eq. (2)

$$CCD_{i,t} = \gamma_0 + \gamma_1 DFI_{i,t} + \gamma_2 DT_{i,t} + \gamma_3 Size_{i,t} + \gamma_4 Lev_{i,t} + \gamma_5 ROE_{i,t} + \gamma_6 Grwoth_{i,t} + \gamma_7 Top1_{,t} + \gamma_8 TobinQ_{i,t} + \gamma_9 Opinion_{i,t} + \sum Year_{i,t} + \sum Industry_{i,t} + \nu_{i,t}$$

Eq. (3)

3.2.3. Moderating effect regression model construction

To explore the moderating effects of CEO Green Experience (CGE) on the DFI-CCD dynamics, two models are formulated to capture both the direct and interaction impacts, represented in Equations (4) and (5):

Direct Moderation Model:

$$CCD_{i,t} = \delta_0 + \delta_1 DFI_{i,t} + \delta_2 CGE_{i,t} + \delta_3 Size_{i,t} + \delta_4 Lev_{i,t} + \delta_5 ROE_{i,t} + \delta_6 Growth_{i,t} + \delta_7 TOP1_{i,t} + \delta_8 TobinQ_{i,t} + \delta_9 Opinion_{i,t} + \sum Year_{i,t} + \sum Industry_{i,t} + \xi_{i,t}$$

Eq. (4)

Interaction Effect Model

$$CCD_{i,t} = \theta_0 + \theta_1 DFI_{i,t} + \theta_2 CGE_{i,t} + \theta_3 (DFI_{i,t} \times CGE_{i,t}) + \theta_4 Size_{i,t} + \theta_5 Lev_{i,t} + \theta_6 ROE_{i,t} + \theta_7 Growth_{i,t} + \theta_8 Top1_{i,t} + \theta_9 TobinQ_{i,t} + \theta_{10} Opinion_{i,t} + \sum Year_{i,t} + \sum Industry_{i,t} + \xi_{i,t}$$

Eq. (5)

By virtue of rigorous specification and analytical processes, these models are intended to clarify the complex dynamics that exert an influence on digital transformation in the contemporary corporate context.

4. Result and Discussion

4.1. Descriptive statistics

Table 2 offers a summary of descriptive statistics for a dataset of 22,929 observations from Chinese listed companies, covering variables like Digital Financial Inclusion (DFI), Corporate Charitable Donations (CCD), and Digital Transformation (DT). The DFI variable shows substantial variation with an average of 329.34. CCD averages at 11.65, but it is important to clarify that this value represents the natural logarithm of all non-zero donations, not the actual monetary amounts. DT is notably polarized, with many firms either fully integrating digital practices or not implementing them at all, reflected by an average score of 77.04 out of a possible 100. CEO Green Experience (CGE) is relatively rare, with an average value of 0.02, suggesting that few CEOs have significant environmental credentials. Other metrics such as firm size, leverage, and Tobin's Q also exhibit considerable variation, with firm size averaging at 24.27 (measured by the natural logarithm of total assets), leverage averaging at 0.51, and Tobin's Q averaging at 1.82. These statistics highlight the diverse financial health and market perceptions of the firms in the dataset

Table 2: Summary Statistics

VARIABLE	N	MEAN	SD	MIN	P50	MAX
DFI	22,929	329.34	60.41	193.29	331.92	458.97
CCD	22,929	11.65	6.02	0.00	14.01	17.12
DT	22,929	77.04	42.07	0.00	100.00	100.00
CGE	22,929	0.02	0.13	0.00	0.00	1.00
Size	22,929	24.27	1.17	20.97	24.17	26.43
Lev	22,929	0.51	0.18	0.05	0.52	0.91
ROE	22,929	0.10	0.10	-1.07	0.10	0.41
Growth	22,929	0.15	0.29	-0.58	0.10	4.33
Top1	22,929	0.37	0.16	0.08	0.37	0.74
TobinQ	22,929	1.82	1.35	0.80	1.31	17.73

4.2. Baseline regression

In this section, we present the baseline regression results that assess the impact of Digital Financial Inclusion (DFI) on Corporate Charitable Donations (CCD). The findings, summarized in Table 3, provide insights into the direct relationship between DFI and CCD, as well as the role of various control variables that may influence this relationship.

Column (1) of Table 3 presents the results of a simple linear regression model, where DFI is the independent variable and CCD is the dependent variable. The results indicate a positive and statistically

significant relationship between DFI and CCD, with a coefficient of 0.014 ($p<0.01$). This suggests that a 1% increase in DFI is associated with a 0.014% increase in corporate charitable donations. The significance of this result highlights the potential for digital financial services to facilitate corporate philanthropy by lowering transaction costs, increasing transparency, and expanding access to financial platforms that make it easier for firms to engage in charitable activities. This finding aligns with the growing body of literature suggesting that digital inclusion can drive both economic and social outcomes, particularly by enabling firms to fulfill their CSR objectives more effectively.

Column (2) introduces firm size as a control variable to account for the influence of company scale on charitable giving. The inclusion of firm size provides a more nuanced understanding of the DFI-CCD relationship. While the positive impact of DFI on CCD remains significant ($p<0.01$), the coefficient slightly decreases from 0.014 to 0.011, suggesting that firm size mediates some of the effects of DFI on CCD. In other words, part of the impact that DFI has on corporate charitable donations can be attributed to larger firms having more resources and a broader capacity to engage in philanthropy. Notably, firm size itself has a significant positive effect on CCD, with a coefficient of 1.304 ($p<0.01$), implying that larger firms are more likely to make substantial charitable contributions, likely due to their greater financial capacity and broader CSR commitments.

Column (3) includes additional control variables such as leverage, profitability (ROE), and industry fixed effects. The results continue to show a positive and statistically significant relationship between DFI and CCD ($p<0.01$), albeit with a slightly reduced coefficient of 0.009. The inclusion of these control variables further refines our understanding of the dynamics at play. Leverage is negatively associated with CCD, suggesting that highly leveraged firms may have fewer resources available for discretionary spending on philanthropy. Profitability, measured by Return on Equity (ROE), is positively correlated with CCD, indicating that more profitable firms are better positioned to engage in charitable giving.

These baseline regression results provide robust evidence of the positive role that DFI plays in enhancing corporate charitable donations. The findings highlight the importance of digital financial services in promoting corporate social responsibility by facilitating easier and more transparent charitable activities. Moreover, the significant role of firm size underscores that larger firms, with more resources at their disposal, are better able to leverage digital financial tools for charitable purposes.

Our results also suggest that while DFI has a direct positive impact on CCD, firm-specific characteristics such as size, leverage, and profitability are crucial in shaping how firms engage in corporate philanthropy. Larger and more profitable firms are well-positioned to benefit from digital financial inclusion and are more likely to use these tools to enhance their charitable efforts. This finding has important implications for policymakers and business leaders, as it highlights the need to foster an enabling environment for digital financial services, particularly for small- and medium-sized enterprises (SMEs), which may face barriers in accessing these platforms.

Table 3: Baseline regression

	(1)	(2)
Variables	CCD	CCD
DFI	0.014***	0.011***
	(0.001)	(0.001)
Size		1.304***
		(0.038)
Lev		-1.367***
		(0.244)
ROE		4.192***
		(0.313)
Growth		0.239
		(0.097)
Top1		2.268***
		(0.273)
TobinQ		0.164***
		(0.029)
Opinion		0.020
		(0.239)
Constant	5.135***	21.754***
	(0.209)	(0.850)
Observations	22,929	22,929
R-squared	0.020	0.102
Adj.R^2	0.020	0.102
IND	FE	FE
YEAR	FE	FE

The significance level is denoted by *** for 1%, ** for 5%, and * for 10%.

4.3. Analysis of mediating effects

In this section, we analyze the mediating role of Digital Transformation (DT) in the relationship between Digital Financial Inclusion (DFI) and Corporate charitable donations (CCD) using a three-step regression approach. As shown in Table 4. Initially, DFI significantly influences DT (coefficient = 0.062, $p<0.01$), indicating that increased financial inclusion boosts digital initiatives. Subsequently, DFI directly impacts CCD (coefficient = 0.110, $p<0.01$), affirming its direct role in promoting charitable activities. Finally, incorporating DT as a mediator reveals its significant but smaller effect on CCD (coefficient = 0.008), highlighting DT's role in facilitating the impact of DFI on CCD.

The analysis confirms that digital transformation acts as a partial mediator in the relationship between digital financial inclusion and corporate charitable donations, aligning with theoretical expectations that technology and financial inclusion foster corporate social responsibility through enhanced capabilities and resources.

Table 4: Mediating effects regression

	(1)	(2)
Variables	DT	CCD
DFI	0.062***	0.110***
	(0.005)	(0.001)
DT		0.008
		(0.001)
Size	15.985***	1.431***
	(0.283)	(0.040)
Lev	-21.709***	-1.194***
	(1.830)	(0.244)
ROE	31.731***	3.939***
	(2.347)	(0.314)
Growth	6.761***	-0.293***
	(0.728)	(0.097)
Top1	-23.837***	-2.458***
	(2.050)	(0.274)
TobinQ	1.990***	0.146***
	(0.218)	(0.029)
Opinion	-5.082**	-0.020
	(1.793)	(0.239)
Constant	288.630***	24.053***
	(6.370)	(0.886)
Observations	22,929	22,929
R-squared	0.220	0.105
Adj.R^2	0.220	0.105
IND	FE	FE
YEAR	FE	FE

The significance level is denoted by *** for 1%, ** for 5%, and * for 10%.

4.4. Analysis of moderating effects

We investigated the moderating effects of CEO Green Experience (CGE) on the relationship between Digital Financial Inclusion (DFI) and Corporate Charitable Donations (CCD) through a two-stage regression analysis, as detailed in Table 5. Initially, both DFI and CGE independently exhibited significant positive impacts on CCD, with coefficients of 0.012 ($p<0.01$) and 3.059 ($p<0.01$), respectively, suggesting that CEOs with environmental expertise significantly boost donations. Further analysis with the interaction term (DFI_CGE) yielded a coefficient of 0.017, affirming that CGE not only enhances DFI's effect on CCD but also amplifies its influence on charitable giving. This underscores the efficacy of environmentally conscious leadership in utilizing digital tools for philanthropy and supports the integration of such leadership to advance corporate social responsibility.

Table 5: Moderating effects regression

	(1)	(2)
Variables	CCD	CCD
DFI	0.012***	0.011***
	(0.001)	(0.001)
CGE	3.059***	5.837***
	(0.340)	(1.773)
DFI_CGE		0.017
		(0.005)
Size	1.287***	1.286***
	(0.038)	(0.038)
Lev	-1.411***	-1.409***
	(0.244)	(0.244)
ROE	4.169***	4.168***
	(0.313)	(0.313)
Growth	0.230***	-0.231***
	(0.097)	(0.097)
Top1	2.281***	2.278***
	(0.273)	(0.273)
TobinQ	0.162***	0.162***
	(0.029)	(0.029)
Opinion	0.030***	0.032***
	(0.239)	(0.239)
Constant	21.409***	21.374***
	(0.849)	(0.850)
Observations	22,929	22,929
R-squared	0.096	0.105
Adj.R^2	0.096	0.105
IND	FE	FE
YEAR	FE	FE

The significance level is denoted by *** for 1%, ** for 5%, and * for 10%.

4.5. Robustness test

Robustness tests were conducted to ensure the reliability and stability of our findings regarding the impact of Digital Financial Inclusion (DFI) on Corporate Charitable Donations (CCD). These tests involved substituting the independent variable and applying fixed company effects, as detailed in Table 6.

To assess the robustness of our results, we replaced the original DFI measure with an alternative measure. Specifically, the proxy variable for DFI was replaced from a provincial to a municipal level, thereby narrowing down the regional scope and providing a more granular measure of digital financial inclusion. The original measure, which was based on provincial-level data, was substituted with municipal-level data to capture variations in DFI more precisely within smaller geographic areas. This

substitution helps to address potential aggregation bias and provides a clearer picture of how digital financial inclusion at a more localized level impacts corporate charitable donation. The substitution yielded a significant coefficient of 0.012 for CCD ($p<0.01$). This indicates that regardless of the specific measure of digital financial inclusion used, there is a consistent and positive relationship between DFI and CCD. This substitution confirms that our findings are not dependent on a particular operationalization of DFI, enhancing the generalizability of our results.

Applying fixed company effects in our analysis controls for unobserved heterogeneity by accounting for time-invariant characteristics of the firms. This approach ensures that the observed relationship between DFI and CCD is not confounded by factors specific to individual companies that do not change over time. With fixed company effects, the impact of DFI on CCD was notably positive, enhancing the coefficient to 0.016 at a 1% significance level. This further validates our findings, demonstrating that the positive effect of DFI on CCD remains robust even when accounting for company-specific variations.

The robustness tests conducted provide strong evidence that our findings are stable and reliable. The consistent positive coefficients across different model specifications and variable substitutions underscore the robustness of the relationship between digital financial inclusion and corporate charitable donations. The robustness of our results has significant implications for both academic research and practical applications. For researchers, the findings highlight the importance of considering alternative measures and controls to ensure the validity of their results. Our approach of substituting the independent variable and applying fixed effects can serve as a methodological benchmark for future studies examining similar relationships.

Table 6: Substitution of variable and Fixed company

VARIABLES	Substitution of independent variable	Fixed company
	CCD	CCD
DFI	0.012***	0.016***
	(0.001)	(0.001)
Size	1.340***	1.402***
	(0.039)	(0.041)
Lev	-1.612***	-0.946***
	(0.256)	(0.264)
ROE	4.180***	3.758***
	(0.328)	(0.322)
Growth	0.267	0.223
	(0.101)	(0.100)
Top1	2.644***	2.589***
	(0.286)	(0.287)
TobinQ	0.178***	0.179***
	(0.030)	(0.030)
Opinion	0.044	0.342
	(0.253)	(0.247)
Constant	22.084***	22.351***
	(0.901)	(0.996)

Observations	22,929	22,929
R-squared	0.105	0.145
Adj.R^2	0.105	0.143
IND	FE	FE
YEAR	FE	FE

The significance level is denoted by *** for 1%, ** for 5%, and * for 10%.

4.6. Endogeneity issues

To address potential endogeneity concerns in our analysis of the relationship between Digital Financial Inclusion (DFI) and Corporate Charitable Donations (CCD), we implemented Propensity Score Matching (PSM) and the Heckman two-stage method, as detailed in Table 7. Endogeneity can arise from various sources, including omitted variable bias, reverse causality, and measurement error, which can lead to biased and inconsistent estimates.

PSM is a statistical technique used to mitigate selection bias by creating a matched sample of treated and control units that are comparable in observed characteristics (Li et al., 2013; Shipman et al., 2017). By ensuring that the treatment (DFI) and control groups are similar, PSM helps isolate the effect of DFI on CCD. Our PSM analysis revealed a significant positive effect of DFI on CCD with a coefficient of 0.026 ($p<0.01$). This indicates that firms with higher levels of digital financial inclusion are more likely to engage in corporate charitable donations compared to similar firms with lower levels of DFI.

The Heckman two-stage method is used to correct for sample selection bias, which occurs when the sample used in the analysis is not randomly selected from the population (Winship & Mare, 1992). The first stage involves estimating a selection equation to model the probability of a firm being included in the sample. We used variables such as firm size, leverage, and market valuation in the selection equation but excluded these variables from the second-stage outcome equation to avoid perfect multicollinearity. The economic argument for excluding these variables is based on their influence on the firm's likelihood of being selected into the sample rather than directly affecting the amount of charitable donations. The inverse Mills ratio obtained from the first stage is then included as a regressor in the second-stage outcome equation to control for selection bias. Our Heckman two-stage analysis adjusted the influence of DFI on CCD to a robust coefficient of 0.012 ($p<0.01$). This adjustment confirms that the positive relationship between DFI and CCD is not due to sample selection bias but represents a genuine effect of digital financial inclusion on corporate philanthropy.

We also conducted multicollinearity tests to ensure the robustness of our regression models. The variance inflation factor (VIF) values for all variables were below the commonly accepted threshold of 10, indicating that multicollinearity is not a concern in our analysis (Chen et al.,2024). The use of PSM and the Heckman two-stage method addresses critical endogeneity issues, enhancing the credibility of our findings. By mitigating selection bias and correcting for sample selection bias, these methods ensure that our estimates reflect the true impact of DFI on CCD.

Table 7: PSM and Heckman endogeneity test

	PSM	Hecakman two-stage
Variables	CCD	CCD
DFI	0.026***	0.012***
	(0.014)	(0.001)
Size	0.720***	1.532***
	(0.020)	(0.104)
Lev	-0.089***	-2.283***
	(0.019)	(0.462)
ROE	0.264	3.205***
	(0.018)	(0.525)
Growth	0.05***	0.668***
	(0.015)	(0.207)
Top1	0.05	3.963***
	(0.015)	(0.775)
TobinQ	0.012***	0.341***
	(0.017)	(0.081)
Opinion	0.015	0.414***
	(0.015)	(0.303)
Constant	0.001	20.014***
	(0.014)	(1.129)
Observations	22,929	22,929
R-squared	0.096	0.102
Adj.R^2	0.096	0.102
IND	FE	FE
YEAR	FE	FE

The significance level is denoted by *** for 1%, ** for 5%, and * for 10%.

4.7. Heterogeneity test

To explore boundary conditions, we tested for heterogeneity across different regions and ownership structures. The analysis reveals that the impact of Digital Financial Inclusion (DFI) on Corporate Charitable Donations (CCD) varies significantly based on these factors.

First, we examined regional differences across China's Eastern, Central, Western, and Northeastern areas. As shown in Table 8, DFI significantly promotes CCD in all regions. The effect is most pronounced in the Northeast (β=0.024), followed by the East (β=0.012), Center (β=0.011), and West (β=0.008). These findings suggest that regional economic and cultural contexts shape the effectiveness of digital finance in fostering corporate philanthropy (Aziz & Naima, 2021; Zhang et al., 2024), highlighting the need for tailored regional strategies (Chen & Li, 2024).

Next, we analyzed the effect of property rights by comparing state-owned enterprises (SOEs) with non-state-owned enterprises (non-SOEs). DFI positively influences CCD in both groups, but the effect is slightly stronger in non-SOEs (β=0.012) than in SOEs (β=0.010). This indicates that while DFI has a universal benefit, ownership structure moderates its impact, with non-SOEs leveraging digital tools more effectively for philanthropic purposes (Chen et al., 2021).

Table 8: Heterogeneity Test Results

Variables	(1) Eastern	(2) Western	(3) Northeastern	(4) Central	(5) SOEs	(6) Non-SOEs
DFI	0.012***	0.008***	0.024***	0.011***	0.010***	0.012***
	(0.001)	(0.002)	(0.005)	(0.002)	(0.001)	(0.001)
Size	1.190***	1.822***	1.445***	1.558***	1.705***	1.445***
	(0.047)	(0.103)	(0.218)	(0.115)	(0.050)	(0.070)
Lev	-0.467	-1.758	-3.511	-5.516	-0.814***	-1.866***
	(0.313)	(0.617)	(1.319)	(0.686)	(0.308)	(0.449)
ROE	4.035***	4.623***	4.498***	4.264***	3.768***	3.115***
	(0.400)	(0.866)	(1.393)	(0.872)	(0.372)	(0.655)
Growth	0.172***	0.547***	0.089***	0.230***	0.553***	0.030***
	(0.130)	(0.228)	(0.388)	(0.256)	(0.116)	(0.195)
Top1	2.142***	2.117***	2.875***	5.449***	0.391***	3.036***
	(0.345)	(0.731)	(1.464)	(0.774)	(0.349)	(0.519)
TobinQ	0.176***	0.089***	0.012***	0.184***	0.185***	0.024***
	(0.037)	(0.075)	(0.195)	(0.075)	(0.033)	(0.067)
Opinion	0.094***	0.973***	0.554***	1.029***	0.541	0.253
	(0.311)	(0.561)	(1.183)	(0.740)	(0.274)	(0.592)
Constant	20.092***	32.880***	28.726***	23.216***	30.664***	26.320***
	(1.053)	(2.287)	(5.059)	(2.589)	(1.142)	(1.642)
Observations	14,971	2,714	861	2,872	8,331	13,087
R-squared	0.096	0.170	0.114	0.118	0.125	0.120
Adj. R2	0.095	0.167	0.106	0.115	0.125	0.119
IND FE	Yes	Yes	Yes	Yes	Yes	Yes
YEAR FE	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors are in parentheses.
*Significance is denoted by *** for p<0.01.*

5. Conclusions

This study investigates the impact of Digital Financial Inclusion (DFI) on Corporate Charitable Donations (CCD), confirming a significant positive relationship using data from Chinese-listed firms (2015–2022). Our findings show that DFI enhances corporate philanthropy by making donation processes more efficient and transparent. Digital Transformation (DT) partially mediates this effect, indicating that firms with greater digital maturity are better able to leverage DFI to amplify their charitable giving. Furthermore, CEO Green Experience (CGE) positively moderates this relationship;

environmentally conscious leaders are more effective at utilizing digital financial tools to advance their company's social responsibility agenda.

Heterogeneity analysis reveals that the DFI-CCD link is strongest in China's Northeastern region and more pronounced in non-state-owned enterprises (non-SOEs), highlighting the influence of regional and ownership contexts.

For businesses, the implications are to strategically invest in digital technologies and foster leadership committed to sustainability to enhance CSR impact. For policymakers, our findings suggest that promoting DFI can be an effective strategy for encouraging sustainable business practices. Supporting digital adoption and creating a regulatory environment that rewards integrated social and economic objectives are crucial steps.

This study has several limitations. First, its focus on Chinese firms may limit the generalizability of the findings; future research should include diverse geographical contexts. Second, despite robust methods like PSM and the Heckman two-stage model to address endogeneity, unobserved variables may still exist. Future work could employ experimental designs for stronger causal inference. Third, mechanisms beyond DT, such as organizational culture or innovation capabilities, were not explored and represent a promising avenue for further investigation. Finally, the dynamic nature of digital finance calls for longitudinal studies and research into emerging technologies like AI and blockchain to understand their evolving role in CSR.

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